Comment on charm cross sections - I

Attempt to reconcile charm cross sections with the data.

Work back from ν interactions to get the flux required to make these interactions.

Use this derived ν flux to estimate the total charm cross section in the dump.

Eventually, we will evaluate the data more thoroughly so that our estimates are internally consistent, limited mostly by Monte Carlo systematics

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Formulae:

$$N_{int} = \phi \cdot \sigma(\nu N) \cdot N_0 \cdot \rho \cdot L \cdot \varepsilon_{tgt} \cdot \varepsilon_{exp}$$

$$\Rightarrow \phi = \frac{N_{int}}{\left(\frac{\sigma}{E_\nu}\right) \cdot \langle E_\nu \rangle \cdot N_0 \cdot \left(\frac{M_{tgt}}{area}\right) \cdot \varepsilon_{tgt} \cdot \varepsilon_{exp}} \qquad (1)$$

Where :

ϕ neutrino flux

M_{tgt} emulsion mass

ε_{tgt} flux in target

ε_{exp} efficiency for extracting N_{int}

N_{int} number of observed ν int.

$area$ area of emulsion

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Formulae (cont'd)

$$\phi = \frac{\sigma_{c\bar{c}}}{\sigma_{pp}^{inel}} \cdot n_{pot} \cdot A^{0.3} \cdot B \cdot n_{\nu}$$

$$\Rightarrow \sigma_{c\bar{c}} = \frac{\phi \cdot \sigma_{pp}^{inel}}{n_{pot} \cdot A^{0.3} \cdot B \cdot n_{\nu}} \qquad (2)$$

where $B = f(0.07) + (1 - f)(0.17)$

and f is the fraction of D^0 mesons

$n_{\nu} =$ (no. D per int.) $\times$ (ν_e or ν_{μ}) $= 4$

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Assumptions

- ϕ varies only a little over *area*
- σ_{cc} is only from D^0 and D^+
- N_{int} are all ν interactions
- $d\sigma/dx_F \sim (1-x_F)^{7.7}$
- $\sigma_{cc} \sim A^1$

Numbers

$(\sigma/E) = 5.1\text{x}10^{-39}\ \text{cm}^2\text{GeV}^{-1}$

$\langle E\rangle = 80$ GeV

$\varepsilon_{tgt} = 0.071$

$N_0 = 6.02\text{x}10^{23}$

$M_{tgt} = 2.6\text{x}10^5$

area = 2.5x103

$\sigma_{inel} = 35\text{x}10^{-27}$

$N_{pot} = 3.6\text{x}10^{17}$

$A = 184$

$\varepsilon_{trig} = \varepsilon_{strip} = \varepsilon_{scan} = \varepsilon_{pot} = 0.95$

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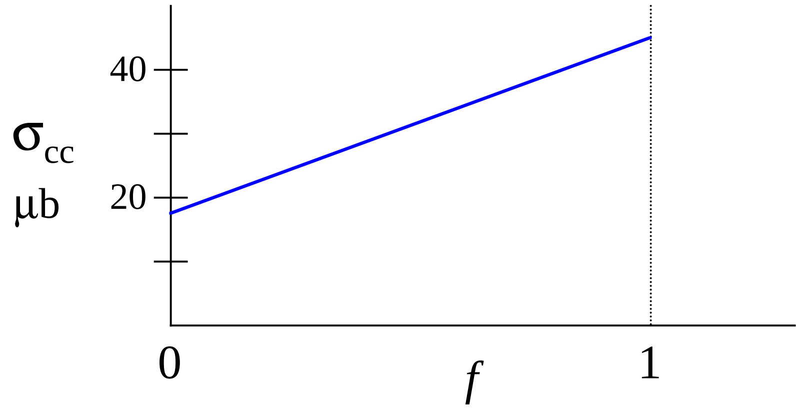
Results

$\boxed{\phi = 3\text{x}10^{14}}$ ν s passing through the target *area*

Then, substituting ϕ into (2):

$$\boxed{\sigma_{c\bar{c}} = \frac{3\times 10^{-30}\,cm^2}{B} = \frac{3\,\mu b}{B}}$$



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Summary

This crude prediction gives a large cross section by itself.

- including other charm states tends to *increase*
- decreasing n from 8 to 5 *decreases* result by 30%
- Our actual N_{int} may be a lot *less*
- The E789 datum is relatively important:

$$\sigma_{D^0}\left(800\,GeV\ pp\right) = 18\,\mu b \pm 1\left(stat\right) \pm 3\left(sys\right)$$

Scaling from n = 8 to 5 *increases* value to

$$\sigma_{D^0}\left(scaled\right) \cong \frac{9}{6} \cdot 18 = 27\,\mu b$$